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Healthcare Analytics in Navy Medicine
Perspectives and Methods for Decision-Making

FOCUS ON RISK ADJUSTMENT

An Introduction to the MHS Risk Adjustment Model

Geof Hileman, FSA, and Robert Opsut, PhD

Experienced healthcare analysts know that apparent differences in cost or utilization measures can be caused by many diverse factors. For example, a group of seven year-old girls is likely to have much lower average health care costs than a group of 62 year-old retirees. Similarly, two groups with similar demographics but different levels of disease burden will exhibit very different patterns of cost and utilization. One of the major challenges in conducting analyses of healthcare cost and use data is properly adjusting for demographic and health status differences in the underlying populations. This article provides an introduction to risk adjustment in order to assist the reader in better understanding its application in the context of financial adjustment (e.g., capitation payments) and non-financial uses (e.g., population cohort management).

Prior to this year, the MHS has primarily addressed this issue through the use of "equivalent lives" , a demographic-based risk adjustment measure. The equivalent lives factors, available in both the M2 and MDR, represent an expected relative risk level based on age group, gender, and beneficiary category. The factors are intended to be relative to an average person. For example, a 53 year-old female non-active duty family member carries an equivalent lives factor of 2.01, indicating that an average individual in this demographic has about double the average expected cost per person across the MHS.

While the equivalent lives approach to demographic risk adjustment helps explain some differences between groups, it does not account for the wide variation at a person level due to individual health conditions. Effective in 2014, a new tool will be available to MHS analysts that will refine this capability to adjust for differences between two populations. Health Affairs has led the development of the MHS Risk Adjustment Model, a diagnosis- and pharmacy-based risk adjustment model that takes into account not only demographics, but also diagnostic and pharmacy history in evaluating the relative risk of each individual.

Structure of the MHS Model

The MHS Risk Adjustment Model maps most diagnoses recorded over a twelve month period into one of 92 condition categories, each with an associated weight. Likewise, pharmacy records are also mapped into one of 24 categories, which also carry their own weights. For each individual, the risk score is the sum of the weights for each of the categories into which that individual was classified. The model also includes constant terms that are added to the risk score when appropriate – an intercept term applicable to everyone, a constant for active duty personnel reflecting the cost of readiness activities, and a constant for individuals born during the data period reflecting newborn costs not specific to a particular diagnosis. Finally, some of the condition categories are hierarchical. That is, there are multiple levels of severity, each with their own weight. For these categories, only the most severe within the hierarchy is retained in the calculation of the risk score.

While diagnosis-based risk scores will be made available in the MDR on the eligibility records of all MHS-eligible beneficiaries, the model is specifically designed to work best for Prime enrollees (with either MTF or civilian PCMs) with at least nine months of experience during the data period, plus those who die or are born during

IN THIS ISSUE

Volume 3 • Issue 4

the year. This is because MHS data for individuals with less than nine months of Prime experience may not fully reflect the diagnostic profile of those individuals. For individuals with less than nine months of Prime experience, a demographic-only risk score has been developed so that entire population groups can be analyzed together. More information on the various data elements available in the MDR is provided in the "Data and Information Systems" column in this issue.

It is also important to note that the MHS Risk Adjustment Model has been developed as an explanatory model, not as a predictive model. This means that diagnosis and pharmacy data from a given year are used to explain costs in that same year. A predictive model, by contrast, uses diagnoses from one year to anticipate costs in the subsequent year. The explanatory approach used in the MHS model provides the MHS analyst community with a tool to adjust historical results for differences in underlying health conditions and also includes a wider range of conditions. Pregnancy, for example, is a condition that is highly explanatory in the current year but not very predictive of costs in a subsequent year.

Potential Uses of the MHS Model

In addition to the person-level risk scores, the MDR will ultimately also contain indicators for each of the diagnosis- and pharmacy-based categories. We anticipate that the risk score and the condition index data will have multiple uses for analyses and research studies. Initially, we see both financial and clinical applications for the model (Figure 1).

The most immediate potential application is in the retrospective analysis of cost levels and cost trends, particularly when comparing across multiple regions or enrollment facilities. Much like the current use of the equivalent lives factors, the risk adjustment factors can serve as the denominator in any cost per enrollee calculation. By adjusting for health status, analysts can gain additional insight into relative costs over time and across localities. Similarly, the risk adjustment model may also be used as the backbone of an equitable financial transfer arrangement. In a fully (unadjusted) capitated environment, a fixed amount per individual per month would be provided to each capitated entity (such as a Service or a facility). Risk adjustment allows that capitation payment to be adjusted for the health status of the enrolled population, greatly reducing the financial risk to the capitated entity.

Figure 1. Potential Uses

Potential Uses for Risk Adjustment in the MHS

- Backbone for capitation-based funding approaches
- Analysis of staffing levels and requirements, particularly in the Patient-Centered Medical Home setting
- Correcting for health status differences in retrospective analysis of costs and cost trends
- Identification of beneficiaries for case management or disease management
- Normalization of data for clinical outcomes research

Because the model was developed largely based on workload measures, it may be well suited to the analysis of staffing performance and/or needs. For example, the number of providers employed in Medical Home implementations might be compared based on risk-adjusted populations served. While this may not capture the specific risk associated with inpatient and specialty care, an assumption could be made that primary care usage is related to the relative disease burden of the enrolled population. In the Medical Home context, risk-adjusted enrollees per provider measures could be calculated for multiple facilities and compared to measure efficiency.

For a more precise implementation of the risk adjustment model in a medical home setting, alternate weights could be developed specific to primary care burden. Since flags associating beneficiaries with each of the condition categories are available within the MDR, additional regression models could be built to develop weights for alternate versions of the model with different dependent variables. In this instance, relative weighted primary care workload could be used to produce risk scores that are directly applicable to Medical Home staffing and panel sizing questions.

Another use of the risk scores in the model might be to identify candidates for case management by focusing attention on those beneficiaries with the highest disease burdens or those with specific condition category flags. Alternatively, certain combinations of conditions might provide alerts that certain beneficiaries should be considered for case management. This is a use of the new model that clearly would not apply to a model based on demographic variables only.

In some cases it may also be useful to compare treatment outcomes based on the risk scores for the beneficiaries being treated. This could be done in comparison between treatment sites using the same protocols, or the risk-score of a beneficiary might be used as an explanatory variable

in statistical models used to assess or predict outcomes.

While the new MHS Risk Adjustment Model will surely continue to be refined throughout its initial implementation, we are excited about the new opportunities for analysis and, ultimately, improved efficiency and cost savings, that it affords. We believe that the various MHS communities will find uses for this information beyond those few applications that we have already envisioned.

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SKILLS AND METHODS

—BUILDING A NEW RISK ADJUSTMENT MODEL

As detailed in the lead article, a new risk adjustment model specifically tailored to the MHS population is now available in the MHS Mart (M2) and MHS Data Repository (MDR). The development of this model was led by Health Affairs in an attempt to provide MHS analysts with a new tool with which to properly account for the underlying health status of a population of interest. This article describes the approach used to develop this risk adjustment model.

Before setting out to build a completely new risk adjustment model specific to the MHS population, already extant models were surveyed. Most commercially available models were either too expensive or were not transparent and flexible enough to permit adaptation to the MHS population. Rather than starting with a completely blank slate, the developers started with a free and open-source model built by the Wakely Consulting Group, an actuarial consulting firm with specialized expertise in risk adjustment modeling. The Wakely model is itself an adaptation of two other publicly available risk models, one designed for a Medicare population and the other for a Medicaid population.

Clinical Classification

The first major phase in the development of the MHS model was a detailed review and re-mapping of the diagnosis categories from the Wakely model. MHS experience was reviewed for each individual diagnosis code, and the mapping was considered from both a clinical and an actuarial perspective. The specific goal was to create a manageable number of diagnostic categories, each comprised of a set of codes that are clinically similar and indicate a similar level of financial risk.

Adjustments were also made during this clinical classification to reflect health conditions of specific interest to the MHS. For example, additional categories were built into the model to adjust for behavioral health at a much more detailed level than most risk adjusters – 17 distinct categories, including a category for post-traumatic stress disorder (PTSD). Pregnancy and high-risk neonates were also carefully considered, given the importance of these conditions in understanding costs in the MHS. Two categories were also created for two degrees of severity of traumatic brain injury (TBI).

Some diagnosis codes were excluded that have potential for inconsistent coding or abuse, depending on the application of the resulting risk scores. This primarily included codes for symptoms that are so common they are not indicative of a specific condition with associated health risk, such as postnasal drip, unspecified backache, nausea, or other malaise and fatigue. Some codes were also excluded that do not indicate a specific condition but are likely to be paired with other, more specific codes, including "unspecified viral infection in conditions classified elsewhere" or "other ill-defined conditions."

Model Specification

The model specification phase of development included determining the proper dependent variable, developing any necessary business rules, and performing regression modeling to determine the model coefficients. The dependent variable refers to the actual value that the model is attempting to predict. In commercial risk adjustment applications, the dependent variable is most often a value indicative of plan liability, or cost. In the MHS, "cost" is not a straightforward concept. Since the financing of direct care and purchased care is different, typical cost variables cannot be directly compared. In order to create a consistent dependent variable for the model to predict, a weighted workload measure was developed. This measure is the sum of the weighted product of various workload measures, such as RVUs, RWPs, APCs, and mental health bed days, weighted by their respective PPS multipliers. Actual cost was used where no appropriate workload measure exists, such as in pharmacy and ancillary claims. The weighted workload measure was then normalized so that a 1.0 risk score indicates the average weighted workload, or cost, across the system.

Rather than using all claims to produce risk scores, two important business rules were identified to increase the accuracy of the measure. First, any record indicating active duty health screening was completely removed. Often, diagnoses recorded during screenings are "rule-out" diagnoses, where the potential condition is being evaluated but not necessarily present. Second, a requirement was added that, for an individual to be classified into a category based on outpatient diagnoses, at least two instances of that category had to be observed. This minimized the effect of inaccurate coding on the resulting risk scores.

Finally, to develop the weights that underlie the risk score calculation, a series of regression models were developed. These models determined the relative contribution to the overall risk level of each of the diagnostic and pharmacy categories, as well as the contribution of limited demographic information. Some condition categories were dropped from the model during this phase, as their coefficient was not significantly different from zero. Additionally, a demographic-only model was developed so that risk scores could be generated for individuals with limited diagnostic history. In addition to the base model, three alternate sets of weights were developed to measure the relative risk with catastrophic cases removed at different dollar thresholds. Depending on the application of the risk scores, one of the truncated models may be more appropriate for use.

DATA AND INFORMATION SYSTEMS

—NEW RISK ADJUSTMENT DATA IN M2 AND MDR

Risk score information will soon be available in both the M2 and MDR for analysts to access. While the M2 risk score data will be initially limited to two fields, a significant amount of detail will be found in the new MDR tables.

As M2 resources are very limited, the quickest solution to getting risk adjustment information into the system was to repurpose existing but infrequently used fields. The fields "PPS Lives" and "PMPM lives," available in both the TRICARE Relationship Summary and TRICARE Relationship Detail tables, will soon provide M2 users with a diagnosis-based risk score appropriate for comparing the risk of two enrolled populations. The two risk score types that will be loaded into the M2 are the Prime enrollee risk scores with risk both truncated at $100,000 and untruncated (i.e., unlimited). The truncation means that in the development of the risk factors, the maximum amount of financial risk per person was $100,000. This version of the risk score is more appropriate for use with much smaller populations than is the untruncated version, which is more susceptible to the influence of individual outliers.

The risk adjustment tables in the MDR will be a much more comprehensive resource with the addition of two new data tables and several reference tables. The Risk Adjustment table will contain person identifiers so that linkages can be created to other MDR tables, as well as some limited demographic information, including the number of months eligible and enrolled to prime within the data period. In addition to the demographic information, two types of risk scores will be available. The "Accrued Risk Score to Date" is the diagnosis-based risk score for any individual using the diagnosis and pharmacy data available for that person, even for non-Prime beneficiaries where the full picture of health care may not be visible. The "Prime Enrollee Risk Score" is calculated only for eligibles with some Prime enrollment in the data period and is based either on the individual's diagnostic profile (if adequate experience exists) or a demographic score. Within each of the two types of risk scores, four levels of truncation are provided (unlimited, $500k, $250k, and $100k). Finally, a "Risk Source" variable will be included to indicate whether the "Prime Enrollee Risk Score" was calculated using the diagnostic history, demographics only, or was not calculated at all. In addition to the Risk Adjustment table, the Health Risk table will contain disease indicators for each of the various diagnostic and pharmacy categories that comprise the risk adjustment methodology.

Several new reference tables related to the risk scores will also be added to provide additional information that may be of interest to MDR users:

- **Diagnosis Mapping** will detail the mapping from five-digit ICD-9-CM codes to the diagnostic categories, or DXCs, used in the risk model.
- **NDC Mapping** will show the mapping from the drug-level NDC codes to the pharmacy categories, or RXCs, used in the risk model.
- **Weights** will show the actual value of each individual component of the risk score for each of the DXCs and RXCs. The weights are also shown separately for each of the four levels of truncation (unlimited, $500k, $250k, and $100k). A review of this table will indi-

cate the relative risk of each of the various conditions considered in conjunction with all of the other included variables.

- **Demographic Weight** will detail the weights used for each age, gender, and beneficiary category in the demographic-only model that is used for Prime enrollees with less than nine months of enrollment within the data period.
- **Dx Hierarchy** is a more technical table that will show how categories of varying severity levels work together. For example, if a beneficiary has diagnoses that map into both the Medium and High levels of a particular category, only the High condition will count toward the risk score.

NEW KNOWLEDGE

—NOTED PUBLICATIONS

The following report provides an overview of risk assessment and risk adjustment, as well as considerations for implementing risk-adjustment methods.

Issue Brief: Risk Assessment and Risk Adjustment

American Academy of Actuaries, May 2010.

In this issue brief published by the American Academy of Actuaries, the authors describe health risk assessment as "a means of objectively determining whether an individual or group represents a risk that is reasonably close to the population average and, if not, of quantifying the relative deviation from the average." The development of risk scores is also briefly explained, particularly those relying on claims-based data. Results from a Society of Actuaries (SOA) study are also presented in which the predictive accuracy of 12 claims-based health risk-assessment models was evaluated. In general, prospective models explained between 15 and 28 percent of the variation in medical claims costs across individuals, while these models explained more than 90 percent of variation among groups of individuals larger than 500. This distinction in predictive accuracy is important because risk adjustment is typically applied to larger groups.

This issue brief also describes the use of health risk assessment scores to risk-adjust payments to healthcare organizations, and how risk adjustment is currently used by Medicare, Medicaid, the Massachusetts Commonwealth Choice Program, and most employer-based plans. Finally, the report provides an in-depth discussion of the various risk adjustment model development issues under consideration by plans participating in the Patient Protection and Affordable Care Act (PPACA) individual and small group markets. These plans will be subject to risk adjustment beginning in 2014 when coverage begins for newly enrolled beneficiaries. These issues include:

- Which health-based data to incorporate into the models, such as diagnosis data from outpatient and inpatient claims and pharmacy claims data
- How to design models to minimize and prevent "gaming"
- Whether to use an individual risk score or aggregate risk score approach to adjust payments
- Whether to use a prospective (i.e., uses information on health spending indicators from a previous period) or concurrent (i.e., uses information from the current period) risk assessment model
- How to manage the administrative costs associated with implementing a risk adjustment process
- Other issues, such as phased-in implementation, reinsurance, budget neutrality, aligning risk adjustment methodology and premium rate development, and determining which plans to risk adjust

The report concludes that a well-designed risk adjustment model is designed to "balance the tradeoffs between using data that are available in a timely manner, maximizing the model's predictive accuracy, and minimizing the opportunity for gaming, while also ensuring the method can be implemented at a reasonable cost."

The full report can be downloaded at http://www.actuary.org/pdf/health/Risk_Adjustment_Issue_Brief_Final_5-26-10.pdf.

WHAT'S COMING UP

—DEFENSE CONNECT ONLINE (DCO) TRAINING OPPORTUNITIES

BUMED PA&E continues to sponsor a series of monthly DCO presentations on the topic "Populations and Healthcare Systems Performance". Each webinar will be conducted twice at different times, which will allow OCONUS personnel to participate. Specific dates for these webinars are noted below. Participants can connect to the DCO session using the link https://connectcol.dco.dod.mil/population-based-analytics/.

Previous sessions in this series included:

- Introduction to the Series "Populations and Healthcare Systems Performance" – December 17 & 19, 2013
- Defining Cohorts – January 28 & 20, 2014

Upcoming sessions include:

- Variations in Practice Patterns – February 25, 2014 (10:00 a.m. EST) and February 27, 2014 (6:00 p.m. EST)
- Uses of Risk Adjustment Factors – March 25, 2014 (10:00 a.m. EST) and March 26, 2014 (6:00 p.m. EST)
- Inappropriate Utilization – April 22, 2014 (10:00 a.m. EST) and April 24, 2014 (6:00 p.m. EST)
- Incidence and Prevalence – May 2014 TBD
- Leading and Trailing Indicators – June 2014 TBD

Members of the group email lists "Healthcare Analytics Community" or "Healthcare Analytics Publication" will receive additional specifics as they become available. To become a member of either or both lists, please send a request to robert.willis@med.navy.mil.

TIPS AND TRICKS

—*THE GOAL SEEK FEATURE IN EXCEL*

Goal Seek is part of suite of commands under the "What-If Analysis" tool in Excel. This article demonstrates how to use Excel's Goal Seek command.

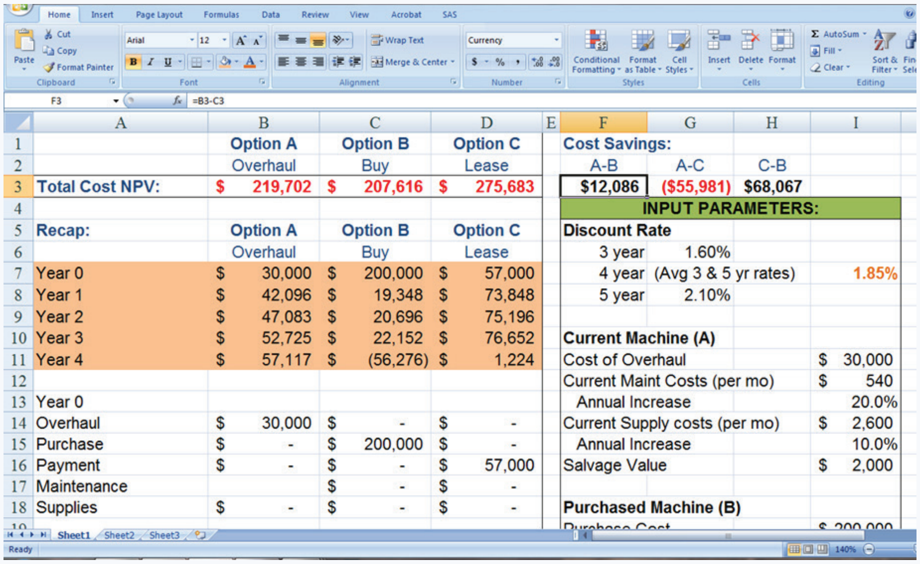
Excel's Goal Seek feature can be useful when you know the result you want from a formula, but you are not sure the input values needed to achieve that result. Goal Seek can also be useful for testing the sensitivity of a result to changes in input values that may be "best guesses" and highly variable. The following step-by-step example shows how Goal Seek can be used.

GOAL SEEK - EXAMPLE

The following example uses an analysis of the total costs associated with a key decision to improve the imaging capability of a facility's Radiology Department. The decision options are to overhaul the existing key imaging machine (Option A), buy a new machine (Option B), or lease a new machine (Option C). The total costs associated with each option are shown, as well as the various input values used to compute the total cost after four years for each option. The cost savings of one option over another are also calculated. Using the Goal Seek feature, an analyst wishes to determine how much the input value associated with overhauling the current machine (Option A) must vary from the existing estimate of $30,000 to make the cost savings of Option B over Option A equal to $0.

1) Select the cell containing the formula that will return the result you are seeking; in this example cell F3 (Figure 1).

Figure 1. An analysis of options to improve the capability of a key imaging machine



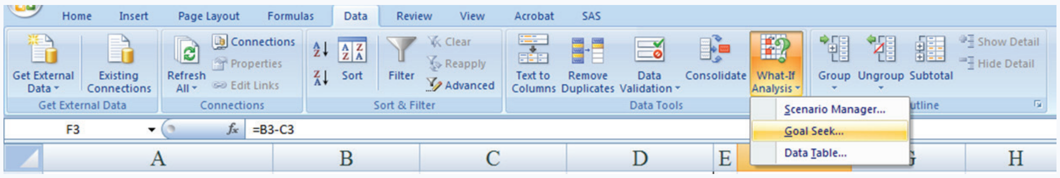
F3 =B3-C3

	A	B	C	D	E	F	G	H	I
1		Option A	Option B	Option C		Cost Savings:			
2		Overhaul	Buy	Lease		A-B	A-C	C-B	
3	Total Cost NPV:	$ 219,702	$ 207,616	$ 275,683		$12,086	($55,981)	$68,067	
4						INPUT PARAMETERS:			
5	Recap:	Option A	Option B	Option C		Discount Rate			
6		Overhaul	Buy	Lease		3 year	1.60%		
7	Year 0	$ 30,000	$ 200,000	$ 57,000		4 year	(Avg 3 & 5 yr rates)		1.85%
8	Year 1	$ 42,096	$ 19,348	$ 73,848		5 year	2.10%		
9	Year 2	$ 47,083	$ 20,696	$ 75,196					
10	Year 3	$ 52,725	$ 22,152	$ 76,652		Current Machine (A)			
11	Year 4	$ 57,117	$ (56,276)	$ 1,224		Cost of Overhaul			$ 30,000
12						Current Maint Costs (per mo)			$ 540
13	Year 0					Annual Increase			20.0%
14	Overhaul	$ 30,000	$ -	$ -		Current Supply costs (per mo)			$ 2,600
15	Purchase	$ -	$ 200,000	$ -		Annual Increase			10.0%
16	Payment	$ -	$ -	$ 57,000		Salvage Value			$ 2,000
17	Maintenance		$ -	$ -					
18	Supplies	$ -	$ -	$ -		Purchased Machine (B)			

GOAL SEEK - EXAMPLE

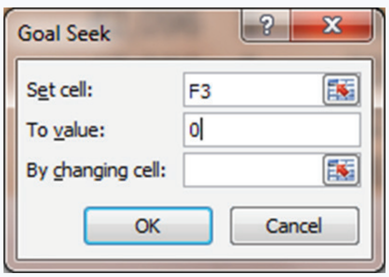
2) On the Data tab, choose What-If Analysis→Goal Seek in the Data Tools group (Figure 2). This action opens the Goal Seek dialog box.

Figure 2. Goal Seek can be found under What-If Analysis tool



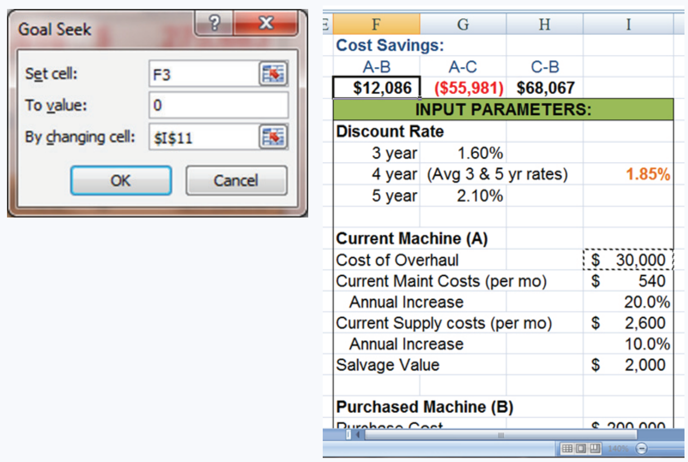
3) Because cell F3 is the active cell when you open this dialog box, the Set Cell text box already contains the cell reference F3. Select the To Value text box and enter the goal. In this example, the To Value is "0" (Figure 3).

Figure 3. Goal Seek dialog box with goal value



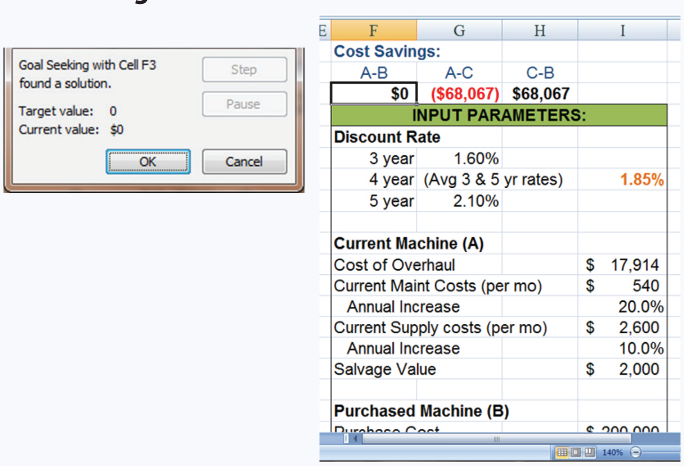
4) Indicate the location of the input value that Excel can change to reach the target, and enter the cell location in the By Changing Cell box. Excel will change the value in this cell reference to try to reach the goal in the To Value box. In this example, cell I11 contains estimated cost of overhauling the current machine. The absolute cell address, I11, appears in the text box (Figure 4).

Figure 4. Goal Seek dialog box indicating necessary input value



5) Click OK. Excel displays the Goal Seek Status dialog box along with the results. In this example, Excel decreases the overhaul cost in cell I11 from $30,000 to $17,914, which, in turn, returns $0 as the cost savings of Option B over Option A in cell F3 (Figure 5).

Figure 5. Final results of Goal Seek



6) If you want to keep the values entered in the worksheet as a result of goal seeking, click OK. If you want to return to the original values, click the Cancel button instead.

KNOWLEDGE SOURCES

—A PERSPECTIVE ON GENERAL SCIENCE PUBLICATIONS

This is the third installment in a series of reviews of general science publications which are useful for professional growth.

Science News, a bi-weekly publication of approximately 32 pages, has focused on succinct science journalism since 1922. In some respects it might be considered a digest of current science topics, but it has the added advantage of providing good references and suggestions for additional reading on the topics it presents. As a result, it allows the reader access to more in-depth information on the subjects of interest.

The subjects presented are very wide-ranging but include a good sampling of issues related to health, medicine, and even healthcare delivery. Thus, almost every issue should have topics that relate in some way to the work of the MHS as well as the personal interests of a variety of readers.

Science News is a magazine of The Society for Science & the Public. Current issues are available without subscription online at http://www.sciencenews.org/, but a subscription is required to access archived material more than 12 months old and other subscriber-only information. Both print and digital editions are available, with one version specifically adapted to Kindle and an iPad version that offers a weekly publication of similar material. A "For Kids" version is also available.

IN THE NEXT ISSUE

The next issue of *Healthcare Analytics in Navy Medicine* will focus on the upcoming transition from the *International Classification of Diseases, 9th Edition, Clinical Modification* (ICD-9-CM) code set to the *International Classification of Diseases, 10th Edition, Clinical Modification/Procedure Coding System* (ICD-10-CM/PCS) code set. ICD code sets are used to identify all inpatient and outpatient diagnoses and those procedures performed in inpatient hospital settings. An explanation of why this transition is taking place, as well as the timeline of the transition, will be discussed. The next issue will also highlight potential implications of this transition on processes, analyses, and policies.

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